RIVER SHANNON.

RETURN to an Order of the Honourable The House of Commons, dated 20 June 1867;—*for*,

COPY "of REPORT by Mr. *J. F. Bateman* on the INUNDATIONS of the RIVER SHANNON."

Treasury Chambers,
20 June 1867.

GEORGE WARD HUNT.

RIVER SHANNON INUNDATIONS.

To the Lords Commissioners of Her Majesty's Treasury.

16, Great George-street, Westminster,
7 June 1867.

May it please your Lordships,

IN compliance with the instructions which I had the honour of receiving from your Lordships, in pursuance of Treasury Minute, 21st May 1866, I beg to present the following report.

Your Lordships' instructions are of a very comprehensive character. They require, in addition to the full investigation of the subject, careful designs, "with quantities and prices" of each work. Elaborate surveys and calculations have consequently been necessary. The river has in many respects so changed since the publication of the Ordnance maps, and the alterations made by the Shannon Commissioners vary so much from their original designs, that no sound or proper conclusion as to the works required could be made without such preliminary surveys. Unfortunately the weather of last autumn and throughout the winter, almost up to the present time, has been unsuited to out-door observations of this nature; and the river has been so continuously flooded, that a much longer time than was anticipated has been absorbed in the surveys and in the examination of the ground in which new works would have to be constructed. I mention these particulars for the purpose of explaining the reason of the apparent delay in completing my commission.

The report on the same subject which I had the honour of presenting on the 7th May 1863 so fully explains, I think, the general character of the river in its several divisions, and the provision to be made for preventing the inundation of the adjacent lands, that I need scarcely again refer to those points.

Your present instructions are "that works shall be designed which shall "embrace all that is necessary throughout each separate reach or level of the "river, extending from the point called 'World's End' at the lower end, to "Lough Allen at the upper, to secure the lands adjacent to it against the "injurious effects of ordinary winter floods; and which works, it is considered, "will also fully provide against all extraordinary summer floods, such as occurred "in 1861."

I have therefore again carefully investigated the question of the volume of such floods as are here referred to, and the level to which they must be kept down to prevent the adjacent lands from being flooded. The result is, that the conclusions I arrived at in 1863 are in every way confirmed, both by recalculation upon the quantities of water to be dealt with, taking into account the future

future effect of improved drainage upon the River Suck and other tributaries, and by the ascertained elevation of adjoining lands by actual levelling.

By referring to page 5 of my Report of May 1863, your Lordships will find that the flood of August 1861 amounted to about 900,000 cubic feet per minute, as it flowed out of Lough Derg at Killaloe, and to 620.000 cubic feet per minute as it passed over the Meelick Weir. You will also observe that by reference to the registries of the height to which the water had risen throughout the long series of years to which the several lock keepers' returns (as supplied by Mr. Harding) referred, I came to the conclusion that it would be sufficient to provide at Killaloe for a flood of 1,200,000 cubic feet per minute, although the maximum winter floods had amounted to 1,600,000 cubic feet, and at Meelick to provide for a flood of 850,000 cubic feet per minute, although the maximum flood would appear to have been as much as 1,300,000 or 1,400,000 cubic feet per minute, and I therefore proposed, after considering the effect of arterial drainage (see page 7 of same report), "to provide works at Killaloe for " the passage of 1,200,000 cubic feet of water per minute, without allowing the " water to rise on the Callow lands, and at Meelick for the passage of 1,000,000 " cubic feet of water per minute. similarly confining the water to the river " channel, and at all other parts of the river in proportionate quantities, always " keeping down the surface of the river, so that scarcely any of the lands now " flooded should be ever affected."

"These quantities," I remarked, were "considerably more than the floods " which damaged the crops in the autumn of 1861. They would include a fair " proportion of the anticipated increase from extended arterial drainage and " improved cultivation of land, and they were equal to the greatest summer and " autumn floods which had been recorded, though swollen with the increase " due to drainage."

The only alteration which I now propose is to provide for 900,000 cubic feet per minute at Meelick instead of 1,000,000.

Before leaving this branch of the subject, I must again draw attention to " the peculiar circumstances of the flat lands adjoining the Shannon, where a " rise of a few inches is just as destructive to the crops as a rise of many feet, " and where increased depth, after the water is once over the land, adds but " little to the whole acreage covered, a state of things which renders it essential " that all flooding shall be prevented except on occasions of such extraordinary " rain as it would be impossible by any reasonable outlay to provide for." These extraordinary rains "so seldom occur at periods which would be de" structive of crops, that they may be safely disregarded."

I have found little to alter in the general design or material features of the scheme which I sketched out in my report of 1863, and though I have endeavoured in every possible way to reduce the works and their probable cost, I have been unable to do so, having regard to the end to be attained.

In no case can the surface of the water be brought down to, and maintained at, the levels necessary to preserve the adjacent lands from inundation, except by the introduction of sluices at the weirs, which, in many cases, as at Meelick, at Athlone, and at Tarmonbarry, must be so adjusted that they shall be capable of discharging the whole volume of the river without permitting the water to rise many inches above the present level of the weir. The effect of this will be generally to reduce the depth of water several feet at and immediately above the weirs. It is obvious that if nothing more were done, such a reduction in the sectional area of the channel through which the water would have to pass, would require a greater velocity to convey the same quantity of water through the smaller channel. This increased velocity can only be obtained by increased declivity, and it therefore follows, that the mere introduction of sluices, while it would relieve the lands immediately above the weir, would gradually lose its effect as the distance increased, and would produce little or no benefit in the upper portion of a long reach, while at the same time it would so increase the velocity of the stream as injuriously to affect the navigation. Hence no effectual relief can be given except by such enlargement of the channel at all shallow and contracted parts as will reduce the declivity, and consequently the level of the water, so that the lands adjoining the upper reaches shall be freed from floods,

and

and that the velocity shall be consistent with the maintenance of the navigation. The necessity of meeting all these conditions has required very extensive and accurate surveys, and has postponed the determination of the precise works required until all these surveys were completed. Again, after the necessary calculations for effecting these objects had been gone into, and the extent of alteration required had been determined, the nature of the ground in which projected works would have to be constructed had to be examined, for the purpose of estimating the cost, and for making variations, where it appeared, from such subsequent examination, that better ground could be selected, and cheaper works constructed.

Your Lordships will easily understand that such an investigation has involved no ordinary amount of labour and consideration, and that it was impossible to arrive at any sound conclusion without very careful designs and accurate calculation. The designs are all now completed, and I beg to hand copies to your Lordships.

The sluices have been designed so as to be raised by turbine wheels to be worked by the river itself, without manual aid, and to be self-acting in case of neglect on the part of the attendant. By judicious use they will be found highly beneficial. For instance, where they are placed at the foot of lakes or extensive sheets of water, as at Killaloe, at Athlone, at Tarmonbarry and Rossky, at Jamestown, and at Lough Allen, they may be opened at the commencement of heavy rain or wet seasons, so as, without creating an injurious flood below the point of discharge, to pass off the water more quickly than it is received; the result of which will be to lower the surface of the lakes, and to create impounding space for the flood when it subsequently becomes as great or greater in magnitude than the sluices can discharge without raising the water below higher than the prescribed limits. They will also, if first erected, be found especially useful during the execution of such alterations in the bed of the river as are required for deepening or enlargement, by being employed in dry weather, previous to the commencement of such works below the weir, to lower the surface of the water above the weir, and then during the time the lake or river above is refilling, the bed of the river below will be left dry, when the work can be carried on cheaply and rapidly without interruption or obstruction by water. To illustrate this, take the case of works in the bed of the river below Lough Derg. The natural summer volume of the river flowing out of Lough Derg will be about 800 cubic feet per minute; the sluices could discharge, probably, 400,000 cubic feet of water per minute, without injury to the lands below, and at this rate they would lower Lough Derg about one foot in 48 hours. If the sluices were then closed, and no rain were to fall to swell the quantity of water flowing into the lake beyond the dry weather volume of 800 cubic feet per minute, it would require 100 days to refill, during which period all the operations below Lough Derg could be carried on as if they were on dry land. Again, very considerable excavations are required in the reach below Roosky where the river could, in a similar manner, be laid dry for short periods at a time, during which the operations in the river bed could be carried on with facility, only slightly impeded by streams which enter the river in this reach. By working the sluices at Athlone in the same way, and impounding the water in Lough Ree, after the surface had been reduced, the new channels at Bishops Islands and Derryholmes could be excavated with no more water to contend with than that brought down by the River Suck. In these reaches of the river this mode of proceeding could not be resorted to without suspending the navigation for the time, but such suspension might be limited to periods of 10 days or a fortnight with intervening intervals, during which the traffic on the river could be carried on, and the economy in the execution of the works would far outbalance any temporary inconvenience which would occur. Some interruption would arise to the passage of fish up the river during the time that the river bed was comparatively dry, but with respect to salmon, the result would be simply that which takes place in all highland rivers to which salmon resort, where in dry seasons they have to wait in the deeper parts of the river for weeks together before a flood occurs which will allow them to pass up to their spawning grounds.

The accurate surveys which I have now obtained, have enabled me to determine more precisely the works required than I could in my report of 1863; in some cases they are more extensive and more costly, and in others less.

I propose to treat Lough Allen in the manner and for the purpose described in my former report, and, in addition to the alterations then projected at Wooden Bridge, to remove a rocky shoal which exists between Wooden Bridge and Battle Bridge; the effect of which is, to inundate a considerable tract of land which lies above it.

At Jamestown I find that I can only keep down the level of the water in the neighbourhood of Carrick-on-Shannon by the entire removal of the existing weir; by constructing a weir and sluices at the lower end of the narrow part of the river as it passes Jamestown; and by deepening the whole of this portion of the river above the sluices to the broadwater above Jamestown Bridge. The top of the weir in its new place must be nearly level with the depth required for navigation; viz., 6 feet above the upper sill of Jamestown Lock, and the whole of the water in floods must be discharged through sluices, which must create the fall required for bringing the water to them by drawing down the surface to below the level of the top of the weir, so as to prevent the water rising in the lakes at Carrick-on-Shannon, more than 6 inches above navigation level.

At Tarmonbarry the embankments and works which were projected for preventing the flooding of the land adjoining the River Camlin, may, by other arrangements, be dispensed with.

Between Roosky and Tarmonbarry it will be better to excavate new channels in various places, than to deepen and widen the old one as first proposed.

Below Athlone also, this will be the best course with respect to the rapid at Derryholmes; and below Banagher, it is found that the opening of the old channels will be a cheaper mode of treating the river than the construction of a new canal, as recommended in my report of 1863.

At Killaloe, in order to secure the free discharge of the water, it is requisite to deepen the bed of the river for some distance below the weir and below the bridge. The removal of the old arches, which I previously recommended, will then be unnecessary.

These are the main variations in the works I projected in 1863.

With respect to Meelick, where some of the most important works have to be constructed, and where the greatest extent of flooded land will be relieved, I may make a few observations. If the old channels were re-opened, as now proposed, and sluices introduced, very considerable relief to the reach immediately above would be afforded, relief which would extend in a diminishing degree to beyond Shannon Bridge, even if no other works were constructed; but the velocity of the stream at Banagher, at Derryholmes, and at Bishop's Islands, would probably be such that the navigation could not be carried on in times of flood without difficulty, and the beneficial effect of the sluices would nearly disappear before we reached Athlone.

By the proposed sluices at Meelick and at the upper ends of the re-opened channels, the surface of the river at Banagher, in such a flood as that of August 1861, would be reduced in level about two feet six inches, or from that to three feet. In order to maintain the same reduction up the river, it is absolutely necessary to enlarge the channel at Derryholmes and Bishop's Island. Even when these are executed, the water at Shannon Bridge cannot be reduced, in such a flood, to more than the corresponding amount at Banagher, viz., two feet six inches or three feet, and this difference will diminish as you ascend to Athlone. The Callows, immediately below Athlone, cannot therefore be secured from inundation on the occasion of a flood of this volume, except by such judicious management of the sluices at Athlone as will anticipate it by rapidly discharging the water at the commencement of heavy rain, and so creating impounding space for moderating the effect afterwards.

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In this way by discharging water from Lough Ree to the utmost limits within which it can be safely discharged without flooding the land below Athlone before the natural volume of a flood would attain similar dimensions, and by impounding the water in the lough when a flood has increased in volume beyond the limits of safe discharge, it may be that on most occasions all injurious inundation may be avoided, but it will require the execution of all the works which I have laid out, due regard to the interests of the navigation, and judicious management on the part of the sluice-keepers.

By your Lordships' Minute of 21st May 1866, I am restricted to the consideration of the improvements required in the river above World's End; but with this provision, that the results must not injuriously affect the lands or other interests below this point.

To carry out this condition it is essential that no greater volume of water should at any time be sent down the river than would be equal to a flood occurring under the existing state of things. The great extent to which Lough Derg serves as a regulating basin will enable this condition to be complied with if due caution be exercised in discharging water from the lake, and if distinct marks or levels be fixed in the reach between Killaloe and World's End, above which it shall not be lawful to permit the water to rise by any discharge from Lough Derg. When the water reaches this level, it will be the duty of the sluice-keeper at Killaloe to close the sluices to the extent required, to prevent the water rising above the fixed level until the in-coming water overpowers his means of control. This will seldom or never happen if the sluices are properly and judiciously worked, and when it does, it will be in consequence of excessive rain creating a flood beyond that for which provision is made, and when the whole valley above and below Lough Derg, as well as above and below World's End, will be alike affected.

In all cases the lowering of the lakes must be consistent with the interests of the navigation. From the foot of Lough Derg to the head of Lough Ree the depth assumed as necessary for the navigation is seven feet above the upper sills of the locks. From this depth a reduction of a foot may probably be allowed when it is expedient to discharge water in anticipation of a flood.

As respects navigation, the works, if wholly carried out as designed, would effect considerable improvement by reducing the objectionable velocity at Keelogue, at Derryholmes, and at Bishop's Islands, as well as in other places where the waterway is contracted; but in no case has any alteration been proposed with a view to such special improvements. They are the result of works which are required for obtaining channels of sufficient dimensions to carry off the floods without inundating the adjoining land.

The plans, sections, and drawings which I have now the honour of submitting, will show in detail all the works proposed, and the estimate will explain the character and extent of each work. The gross estimated cost is 290,605 *l.*

The interest of this sum will very considerably exceed the estimated annual value of the improvement to be effected. which, according to the valuation of Messrs. Brassington & Gale, and Mr. Lynam, will only amount to 6,113 *l.*

I have prepared a Table showing the area of the land flooded or injuriously affected in each reach, and the cost of the works requisite for relieving the lands from flooding. This Table forms Appendix (A.).

By your Lordship's further instructions, under date of 14th September 1866, I am requested to consider whether, in the event that all the works which may be desired should prove too costly to be undertaken, some improvements could be effected at a reasonable expense, without carrying out the whole.

With reference to this instruction it will be perceived from an examination of the Table just alluded to (Appendix A.), that considerable differences exist in the cost per acre of the works proposed. This arises from the different circumstances of the various reaches of the river. In all cases where it is necessary to widen or deepen the river, the cost of the alterations required, if measured by the relief to be afforded in the same reach, will be greater than the value of the land to be benefitted; but that where the land flooded lies upon the margin of lakes, or upon reaches on the same level, and where the relief to be afforded consists of little more than the introduction of sluices in the weirs at the outlets of those lakes, the cost of the works will not be greater than may be reasonably entertained.

Between Meelick and Athlone, although the works involve a large cost per acre, the navigation will in several places be so improved, and a so much better outlet will be provided for the waters of the River Suck, that some contribution from the parties interested in these improvements might be reasonably looked for, and in this way the cost to the landowner, may perhaps be reduced to a point which will warrant the necessary expenditure.

Thus, although throughout the whole of the river one part is very dependent upon another, there may be certain places at which partial improvements may be effected. The only places, however, in which such partial works could be carried out with anything approaching to safety, having regard to the effect upon the landowners below, are Lough Allen, Jamestown, Athlone, and Killaloe. At Lough Allen much benefit would accrue, and no injury comparatively would be done, by shutting up the floods and discharging them gradually on the cessation of rain. At the three other places the sluice-keeper might be permitted to discharge water by means of the sluices, until the river below attained a level consistent with the preservation of the adjoining land from flooding; then he should gradually close the sluices as the rain increased till, if it were necessary to keep down the water below to the prescribed level, the whole of them should be closed; after which the water passing over the weirs (which would remain of the same discharging power as now) would leave the condition of things as heretofore.

The extent of land which would receive benefit by such partial works it is difficult to compute, for it would only be on the occurrence of slight floods, or during short periods of rain, as continuous rain or heavy floods would soon overpower the means of control. Such partial alterations, therefore, although they would unquestionably confer some benefit, would not entirely or permanently relieve the flooded lands, and they might tend to create false confidence and so lead to occasional loss and disappointment.

I have, &c.
(signed) *John Frederic Bateman*

APPENDICES TO REPORT.

Appendix (A).

TABLE of FLOODED LAND and COST of proposed WORKS in each REACH of RIVER.

REACH OF RIVER	Cost of Works proposed, including 10 per Cent. for Contingencies	Area of Land inundated by Flood of August 1861.	Area of additional Land covered by Winter Floods of 1859–1860.	Area of Land injured by ordinary Winter Floods.	Total Area of flooded and injured Land affected by Proposed Works.	Cost per Acre in each Reach of Works, proposed in each Reach	Add—Proportion of Cost of Works at Lough Allen to Reaches benefitted thereby.*	TOTAL Cost per Acre in each Reach.
	£.	Acres.	Acres.	Acres.	Acres.	£. s. d.	£. s. d.	£. s. d.
Lough Allen - -	10,136	337	–	51	388			
Lough Allen to Battle Bridge - - -	13,124	520	–	103	623	21 1 3½	3 9 6¼ +	24 10 9¾
Battle Bridge to Roosky	28,208	2,205	228	561	2,994	9 8 5	2 6 4 +	11 14 9
Roosky to Tarmonbarry	37,724	749	11	130	890	42 7 8¾	1 3 2 +	43 10 10¾
Tarmonbarry to Athlone	23,266	1,107	1,668	636	3,411	6 16 5	- -	6 16 5
Athlone to Meelick -	119,487	6,704	1,185	1,137	9,026	13 4 9	- -	13 4 9
Meelick to Killaloe -	33,813	1,354	3,773	887	6,014	5 12 5¼	- -	5 12 5¼
Killaloe to World's End	24,847	666	479	52	1,197	20 15 1½	- -	20 15 1½
TOTALS - -	290,605	13,305	7,344	3,506	24,155	(Mean.) 12 – 7¼	- -	(Mean.) 12 – 7¼

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* The cost of the works at Lough Allen must be charged to the districts below, which will be benefited by the retention of the flood waters in the Lough, and in the proportion to the benefit received, say, in the proportion of three-sixths to each acre of land benefited in the district lying between Lough Allen and Battle Bridge, two-sixths per acre to the land surrounding the lakes below Battle Bridge, and from thence to Roosky, and one-sixth per acre to the land lying between Roosky and Tarmonbarry, or in some such proportion.

J. F. Baateman.

Appendix (B).

DESCRIPTION of WORKS required for securing Lands adjacent to the River against the injurious Effects of Ordinary Winter Floods, and such Extraordinary Summer Floods as occurred in 1861; and ESTIMATE of COST.

LOUGH ALLEN.

Lough to be raised five feet above present summer level by an embankment with two sets of sluices at Ballantra Bridge, each set consisting of eight sluices of 24 feet area each, to be worked by turbine wheels; and new lock at the entrance of the Lough Allen Canal, at Drumshambo.

			£. s. d.	£. s. d.	£. s. d.	£. s. d.
Sluices:						
Piling along upper side of sluices - - - -	1,053 cub. ft. -	4 s.	210 12 –			
Concrete under sluices and abutments - - - -	341 cub. yds. -	15 s.	255 15 –			
Ashlar - - - - -	6,962 cub. ft. -	2 s.	696 4 –			
Rubble in mortar, in abutments	123 cub. yds. -	10 s.	61 10 –			
Roughly squared paving and pitching - - - -	1,397 cub. ft -	1 s	69 17 –			
Heavy rubble pitching, two feet deep - - - - -	851 cub. yds. -	8 s.	340 8 –			
Ironwork of sluices, and fixing (for particulars, *see* Appendix (C.) - - - - -	2 sets, at £.700 each		1,400 – –			
Stank, foundations, &c - -	- -	- -	200 – –			
				3,234 6 –		
Embankment in continuation of sluices - - - - -	13,000 cub. yds. -	1 s	- -	650 – –		
Footbridge at Ballantra Outlet of a lake. -	- -	- -	- -	200 – –		
New Lock at Entrance of Lough Allen Canal:						
Concrete under sills and side-walls - - - - -	204 cub. yds -	15 s.	153 – –			
Ashlar - - - - -	7,324 cub. ft. -	2 s.	732 8 –			
Rubble backing - - -	283 cub. yds. -	10 s.	141 10 –			
Wing-walls - - - -	101 cub. yds -	14 s.	70 14 –			
Squared paving beyond stop-gates - - - - -	70 sq. yds. -	6 s.	21 – –			
Two pairs of gates - - -	- -	- -	80 – –			
Excavation, foundations, &c -	- -	- -	51 8 –			
				1,250 – –		
					5,334 6 –	
Land required round Lough Allen (very little changed from its present condition), 388 Acres, at 10 *l.* - - - - - - -				- - - -	3,880 – –	
					9,214 6 –	
Contingencies, 10 per Cent. - - - -					921 14 –	
						10,136 – –
Amount carried forward - - - £.						10,136 – –

	£. s. d.
Amount brought forward - - -	10,136 – –

LOUGH ALLEN TO BATTLE BRIDGE.

Enlargement and diversion of present river course from sluices at Lough Allen to below Lough Nagaliah;
At Drumherriff (Wooden Bridge) :—New stone bridge and excavations in bed of river; and
At Inchagowal :—New foot bridge and excavation in bed of river.
Volume of water provided for:
Lough Allen to Lough Nagaliah, 180,000 cubic feet per minute.
Drumherriff to Battle Bridge, 240,000 cubic feet per minute.

Enlargement and Diversion of present River Course from Sluices at Lough Allen to below Lough Nagaliah:			£. s. d.	£. s. d.	£. s. d.
Excavation - - - -	163,823 cub. yds. - - 9 *d.*	- -	6,113 7 3		
Land for works and spoil -	15 acres at 50 *l.* - -	- -	750 – –		
				6,893 7 3	
DRUMHERRIFF:					
New Stone Bridge:					
Piers and abutments - -	300 cub. yds. - 16 *s.*	240 – –			
Arches - - - -	245 cub. yds. - 13 *s.*	159 5 –			
Backing to arches - -	177 cub. yds. - 8 *s.*	70 16 –			
Spandrells, pilasters, and wing walls - - - -	230 cub. yds. - 13 *s.*	149 10 –			
Stringcourse - - -	787 cub. ft. - 1 *s.* 6 *d.*	59 – –			
Parapet - - - -	58 cub. yds. - 13 *s.*	37 14 –			
Metalling of roadway - -	76 cub. yds. - 3 *s.* 6 *d.*	13 6 –			
Filling in spandrells - -	160 cub. yds. - 1 *s.*	8 – –			
Embankment or approaches -	1,900 cub. yds. - 1 *s.*	95 – –			
Metalling on embankment -	210 cub. yds. - 3 *s.* 6 *d.*	36 15 –			
Centres, foundations, and sundries - - - -	- - - - - -	100 – –			
			969 6 –		
Excavation in River:					
Rock - - - - -	23,178 cub. yds. - 2 *s.* 6 *d.*	2,897 5 –			
Stanks and relieving works from water - - -	- - - - - -	230 – –			
			3,127 5 –		
INCHAGOWAL:				4,096 11 –	
Excavation in Bed of River:					
Excavation—Rock - -	8,562 cub. yds. - 2 *s.* 6 *d.*	820 5 –			
Stanks and relieving works from water - - -	- - - - - -	70 – –			
			890 5 –		
New foot bridge - - -	- - - - - -	- -	50 – –		
				940 5 –	
				11,930 3 3	
		Contingencies, 10 per Cent. - - -		1,193 16 9	
					13,124 – –
		Amount carried forward - - - £.			23,260 – –

	£. s. d
Amount brought forward - - -	23,260 – –

BATTLE BRIDGE TO ROOSKY.

At Jamestown :—Removal of existing weir, and erection of four sets of sluices below same, and excavation in bed of river between Jamestown Bridge and sluices.

New weir or top of frame of sluices to be six feet above upper sill of Jamestown Lock.

The flood water to be discharged through the sluices, so as to prevent the water in the lakes rising more than six inches above navigation level.

Volume of water provided for, 350,000 cubic feet per minute.

Erection of additional arch to bridge at Carnadoe, and cleaning out entrance to same.

At Roosky :—Removal of existing weir and substitution of five sets of sluices, with excavation above and below same.

New weir or top of frame of sluices to be same height as present weir, or six feet above upper sill of Roosky Lock.

Depth to which water may be permitted to rise above weir, eight inches.

Volume of water provided for, 400,000 cubic feet per minute.

			£. s. d.	£. s. d.	£. s. d.	
JAMESTOWN :						
Removal of existing Weir, and Excavation below Jamestown Bridge :						
Excavation : Rock - -	37,000 cub. yds. -	2 s. 6 d.	4,625 – –			
" Gravel - -	33,000 cub. yds. -	1 s.	1,650 – –			
				6,275 – –		
Sluices :						
Concrete under sluices and abutments - - -	619 cub. yds. -	15 s.	464 5 –			
Ashlar - - - -	9,936 cub. ft. -	2 s.	993 12 –			
Blocking facing - - -	84 cub. yds. -	27 s.	113 8 –			
Rubble in mortar in abutments - - - -	102 cub. yds. -	8 s.	40 16 –			
Sluices, four sets, at 700 *l.* -	- - -	-	2,800 – –			
				4,412 1 –		
Stanks, foundations, &c. -	- - -	-	- -	600 – –		
Land for spoil, damage only	- - -	-	- -	400 – –		
					11,687 1 –	
CARNADOE :						
Additional Arch to Bridge :						
Ashlar faced abutment and pilaster - - - -	100 cub. yds. -	18 s.	90 – –			
Ashlar springers, quoins, string-course, and parapet -	1,282 cub ft. -	2 s.	128 4 –			
Arch - - - - -	1,360 cub. ft. -	1 s. 6 d.	102 – –			
Rubble in mortar, backing to arch, &c. - - - -	78 cub. yds. -	10 s.	39 – –			
Wing walls faced with blocking (material in present wall to be used) - -	280 cub. yds. -	6 s.	84 – –			
Re-setting, &c., string-course and coping - - -	200 cub. ft. -	6 d.	5 – –			
Centres, foundations, &c. -	- - -	-	50 – –			
				498 4 –		
Excavation at Bridge and in Approaches - - -	1,112 cub. yds. -	1 s.	- -	55 12 –		
					553 16 –	
ROOSKY :						
Sluices :						
Concrete under sluices and abutments - - -	769 cub. yds. -	15 s.	576 15 –			
Ashlar - - - -	11,875 cub. ft. -	2 s.	1,187 10 –			
Blocking facing - - -	105 cub. yds. -	27 s.	141 15 –			
Rubble in mortar in abutments	116 cub. yds. -	10 s.	58 – –			
Sluices, five sets, at 700 *l.* -	- - -	-	3,500 – –			
				5,464 – –		
Excavation above and below sluices, soft material - -	129,579 cub. yds. -	1 s.	- -	6,478 19 –		
Diversion of River, stanks, and foundations - - - - -	- - -	-	- -	500 – –		
Land for spoil, and alterations in River course, 16 acres, at 60 *l.* - - - - -	- - -	-	- -	960 – –		
					13,402 19 –	
					25,643 16 –	
				Contingencies, 10 per Cent. - - -	2,564 4 –	
						28,208 – –
					Amount carried forward - - - £.	51,468 – –

	£. s. d.
Amount brought forward - - -	51,468 – –

ROOSKY to TARMONBARRY.

At Clooneen, enlargement of existing channel.

Between Lough Forbes and weir at Tarmonbarry, formation of new channel at Lack, and excavations in bed of river above same; excavation in bed of river above and below bridge; removing solid portion of bridge at island, and removing portion of weir at Tarmonbarry, and substituting an iron-girder bridge, and removing portion of weir at Tarmonbarry, and substituting three sets of sluices with salmon ladder.

New weir, or top of frame of sluices, to be same height as present weir, or six feet above upper sill of Tarmonbarry Lock.

Water to be kept down to top of weir.

Volume of water provided for 500,000 cubic feet per minute.

		£. s. d.	£. s. d.	£. s. d.	£. s. d.
CLOONEEN:					
Excavation in widening out existing channel of river, &c., 183,000 cub. yds. at 9 *d.*			6,862 10 –		
Land for alterations and for spoil, 11 acres, at 50 *l.*			550 – –		
				7,412 10 –	
LOUGH FORBES TO WEIR AT TARMONBARRY:					
Excavations:					
New Channel at Lack:					
Soft material	125,850 cub. yds. - 8 *d.*	4,195 – –			
Rock	100,000 cub. yds. - 2 *s.* 6 *d.*	12,500 – –			
			16,695 – –		
In River above new Channel:					
Soft material	35,000 cub. yds. - 8 *d.*	1,166 13 4			
Rock	4,727 cub. yds. - 2 *s.* 6 *d.*	590 17 6			
			1,757 10 10		
In River above and below Bridge, in removing solid portion of Bridge and portion of Weir, and about Sluices:					
Soft material	45,000 cub. yds. - 8 *d.*	1,500 – –			
Rock	7,737 cub. yds. - 2 *s.* 6 *d.*	967 2 6			
			2,467 2 6		
Sluices:					
Ashlar	8,075 cub. ft. - - 2 *s.*	807 10 –			
Rubble in mortar	109 cub. yds. - 8 *s.*	43 12 –			
Dry rubble, filling in pier	23 cub. yds. - 5 *s.*	5 15 –			
Sluices, three sets, at 700 *l.*	- - - - -	2,100 – –			
			2,956 17 –		
Salmon ladder	- - - - -	- -	200 – –		
Additional Opening in Bridge at Island:					
(Wrought-iron girder; span, 94 feet; width of roadway, 17 feet.)	*Tons. cwts. qrs. lbs.*				
Wrought iron	44 16 2 0 - at 18 *l.*	806 17 –			
Cast iron	1 8 2 10 - at 10 *l.*	14 6 –			
Timber flooring	1,301 cub. ft. - - 3 *s.*	204 3 –			
			1,025 6 –		
Land for widening and alterations of river course, and for spoil; 32 acres, at 40 *l.*		- -	1,280 – –		
Stank at sluices, &c., and sundries		- -	500 – –		
				26,881 16 4	
				34,294 6 4	
Contingencies, 10 per Cent. - - -				3,429 13 8	
					37,724 – –
Amount carried forward - - - £					89,192 – –

	£. s. d.
Amount brought forward - - -	89,192 - -

TARMONBARRY TO ATHLONE.

Excavation or enlargement of River Channel at Lodge Cut, Cloonbearlaw, Erra, Crompawn, Kilnacarrow, and Lanesborough.

At Athlone—Removal of portion of existing Weir and substitution of three sets of Sluices, and excavation in bed of River adjoining Sluices.

Top of frame of Sluices to be same height as present Weir, or 6 ft. 9¾ in. above upper sill of Athlone Lock.

Depth to which water may be permitted to rise above Weir, 8½ inches.

Volume of Water provided for:

Between Tarmonbarry and Lough Ree, 550,000 cubic feet per minute.
At Athlone, 450,000 cubic feet per minute.

			£. s. d.	£. s. d.		
Excavation in enlargement of River Channel at—						
Lodge Cut	65,817 cub. yds.	1s.	- -	3,290 17 -		
Cloonbearlaw	3,668 cub. yds.	1s.	- -	183 8 -		
Erra	14,456 cub. yds.	1s.	- -	722 16 -		
Crompawn	29,601 cub. yds.	1s.	- -	1,480 1 -		
Kilnacarrow	22,503 cub. yds.	1s.	- -	1,125 3 -		
Lanesborough	37,665 cub. yds.	1s.	- -	1,883 5 -		
				8,685 10 -		
Land for widening or altering River Channel and for spoil	15 acres, at	50l.	- -	750 - -		
					9,435 10 -	
ATHLONE:						
Sluices:						
Piling at pier, along sluices, and at abutment	15,235 cub. ft.	4s.	3,047 - -			
Concrete under pier, sluices, and abutment	1,059 cub. yds.	15s.	794 4 5			
Ashlar	13,063 cub. ft.	2s.	1,306 6 -			
Rubble in mortar in pier and abutment	577 cub. yds.	10s.	278 10 -			
Roughly squared pitching	4,673 cub. ft.	1s.	233 13 -			
Dry rubble filling in pier	307 cub. yds.	6s.	92 2 -			
Heavy rubble pitching, 2 ft. deep	5,576 cub. yds.	8s.	2,230 8 -			
Sluices, 3 sets at 700l.	- -	-	2,100 - -			
Stank, &c.	- -	-	600 - -			
				10,682 4 -		
Excavation at and adjoining sluices	28,000 cub. yds.	8d.	- -	933 6 8		
Land for spoil	- -	-	- -	100 - -		
					11,715 10 8	
					21,151 - 8	
			Contingencies, 10 per Cent.		2,114 19 4	
						23,266 - -
			Amount carried forward - - - £.			112,458 - -

	£. s. d.
Amount brought forward - - -	112,458 – –

Athlone to Meelick.

At Shannon Bridge:—Removal of portion of island above the bridge, and excavation in bed of river at bridge

At Borniagh:—Enlargement of present cut.

At Bishop's Islands and Derryholmes:—Formation of additional channel and excavation in existing channel.

At Leahinch and Banagher:—Excavations in bed of river.

From Counsellor's Ford to Meelick:—Opening out and enlargement of the two old channels, and erection of three sets of sluices at entrance to each channel:

Top of frame of sluices in each channel to be 9 ft. 6 in. above upper sill of Victoria Lock.
Level of water at Counsellor's Ford to be kept down to 8 ft. 6 in. above upper sill of Victoria Lock.

At Meelick:—Removal of portion of existing weir, and substitution of three sets of sluices, with excavation below same:

Top of frame of sluices to be same height as present weir, or 7 feet above upper sill of Victoria Lock.
Depth to which water may be permitted to rise above weir, 3 inches.

Volume of Water provided for:

Between Athlone and Shannon Bridge, 500,000 cubic feet per minute.

Between Shannon Bridge and junction with Brosna, at Shannon Harbour, 700,000 cubic feet per minute.

Between Shannon Harbour and Meelick, and at Meelick, 900,000 cubic feet per minute.

			£. s. d.	£. s. d.	£. s. d.	£. s. d.
SHANNON BRIDGE:						
Removing portion of island above bridge, and excavation in bed of river at bridge - - -	34,474 cub. yds. - -	8 *d.*	- -	1,115 16 –		
Stank - - - - -	- - -	-	- -	300 – –		
Land for spoil - - -	- - -	-	- -	100 – –		
					1,515 16 –	
BORNIAGH:						
Excavation in enlarging present cut - - - - -	38,000 cub. yds. - -	8 *d.*	- -	1,266 13 4		
Land for alterations and for spoil	4 acres - - - -	at 50 *l.*	- -	200 – –		
					1,466 13 4	
BISHOP'S ISLANDS:						
Excavation in forming additional channel - - - -	320,627 cub. yds. -	8 *d.*	10,687 11 4			
Excavation in existing channel -	96,671 cub. yds. -	8 *d.*	3,222 7 4			
				13,909 18 8		
Land for works and spoil -	25 acres - - -	at 80 *l.*	- -	2,000 – –		
					15,909 18 8	
DERRYHOLMES:						
Excavation in forming additional channel (rock) - - -	154,784 cub. yds. -	2 *s.* 6 *d.*	19,348 – –			
Excavation in existing channel (rock) - - - -	39,248 cub. yds. -	2 *s.* 6 *d.*	4,906 – –			
Stanks, &c. - - - -	- - -	-	650 – –			
				24,904 – –		
Land for works and spoil -	15 acres - - -	at 60 *l.*	- -	900 – –		
					25,804 – –	
LEAHINCH:						
Dredging in bed of river - -	28,731 cub. yds. - -	6 *d.*	- -	718 5 6		
Land for spoil - - -	- - -	-	- -	60 – –		
					778 5 6	
			Amounts carried forward - - -	£.	45,474 13 6	112,458 – –

Athlone to Meelick—*continued.*

		£. s. d.	£ s. d.	£. s. d.	£. s. d
	Amounts brought forward - - -			45,474 13 6	112,458 – –
BANAGHER:					
Excavation in bed of river -	79,000 cub. yds. - 1 s.	- -	3,950 – –		
Stank, &c. - - - -	- - - - -	- -	800 – –		
Land for spoil - - -	4 acres at 50 *l.*	- -	200 – –		
				4,950 – –	
COUNSELLOR'S FORD TO MEELICK:					
Excavation in opening out and enlarging two old channels, and in foundations of sluices at entrance to same - -	918,178 cub. yds. - 10 *d.*	- -	38,257 8 4		
Sluices:					
Piling along upper side of sluices - - - -	2,330 cub. ft. - 4 *s.*	446 – –			
Concrete under sluices and abutments - - - - -	497 cub. yds. - 15 *s.*	372 15 –			
Ashlar - - - - - -	7,172 cub. ft. - 2 *s.*	717 4 –			
Roughly squared paving and pitching - - - -	2,096 cub. ft. - 1 *s.*	104 16 –			
Heavy rubble pitching 2 feet deep - - - - -	1,277 cub. yds. - 7 *s.*	446 19 –			
Rubble in mortar in abutments -	107 cub. yds. - 9 *s.*	48 3 –			
Sluices, three sets at 700 *l.* each	- - - - -	2,100 – –			
	Cost of sluices in each channel - - -	4,235 17 –			
	Total cost for both channels - - -	- -	8,471 14 –		
Bridge over new cut and floats -	- - - - -	- -	1,450 – –		
Stanks, &c. - - - -	- - - - -	- -	220 – –		
Land for Works and Spoil:					
91 acres at 50 *l.* - - -	- - - - -	4,550 – –			
42 acres (at present swamped in old channels) at 20 *l.* - -	- - - - -	840 – –			
			5,390 – –		
				53,789 2 4	
MEELICK:					
Excavation:					
Rock cutting and dressing foundations - - - -	240 cub. yds. - 2 *s.* 6 *d.*	30 – –			
Backing to weir - - -	1,300 cub. yds. - 6 *d.*	32 10 –			
At sluices - - - -	28,000 cub. yds. - 10 *d.*	1,166 13 4			
(Spoil will go to fill old channels.)			1,229 3 4		
Sluices:					
Concrete under sluices - -	60 cub. yds. - 15 *s.*	45 – –			
Ashlar - - - - -	8,361 cub. ft. - 2 *s.*	836 2 –			
Rubble in mortar, in pier and abutment - - - -	118 cub. yds. - 8 *s.*	47 4 –			
Dry rubble filling - - -	68 cub. yds. - 5 *s.*	17 – –			
Heavy rubble pitching, 2 feet deep - - - - -	53 cub. yds. - 6 *s.*	15 18 –			
Sluices, three sets at 700 *l.* -	- - - - -	2,100 – –	3,061 4 –		
Stank - - - - -	- - - - -	- -	120 – –		
				4,410 7 4	
				108,624 3 2	
	Contingencies, 10 per cent. - - -			10,862 16 10	
					119,487 – –
	Amount carried forward - - - £.				231,945 – –

	£. s. d.
Amount brought forward - - -	231,945 – –

MEELICK TO KILLALOE.

At White's Ford:—Enlargement of channel, and excavation in river.

At Killaloe:—Excavations in bed of river, above and below bridge and proposed sluices; removal of portion of existing weir, and substitution of eight sets of sluices; and construction of embankment and wall along the existing navigation channel, from island at pier head to the weir, and on top of weir to the lock wall.

Top of frame of sluices to be same height as existing weir, or 6 ft. 9 in. above upper sill of Killaloe lock.

Depth to which water may be permitted to rise above weir at sluices, 1 ft. 5 in.

Volume of Water provided for:

Between Meelick and Lough Derg, 1,000,000 cubic feet per minute.

At Killaloe, 1,200,000 cubic feet per minute.

		£. s. d.	£. s. d.	£. s. d.	£. s. d.
WHITE'S FORD:					
Excavation in enlargement of channel and in bed of river -	50,000 cub. yds. - - 8 *d.*	- -	1,666 13 4		
Land for works, and spoil -	- - - -	- -	150 – –		
				1,816 13 4	
KILLALOE:					
Excavations in bed of River, above and below Bridge and Sluices, and in removing portion of existing Weir:					
Rock or hard material -	177,785 cub. yds. - - 2 *s.*	17,778 10 –			
Soft material - - -	59,515 cub. yds. - - 9 *d.*	2,231 16 3			
			20,010 6 3		
Sluices:					
Ashlar - - - -	12,508 cub. ft. - - 2 *s.*	1,250 16 –			
Rubble in mortar and dry rubble filling - - -	239 cub. yds. - - 8 *s.*	95 12 –			
Sluices, 8 sets, at 700 *l.* - -	- - - -	5,600 – –			
			6,946 8 –		
Salmon ladder - - -	- - - -	- -	100 – –		
Embankment and Wall alongside Navigation Channel:					
Embankment:					
Rubble hearting - -	647 cub. yds. - 1 *s.* 6 *d.*	50 11 –			
Pitching on slopes -	600 cub. yds. - - 6 *s.*	180 – –			
Wall:					
Rough ashlar - -	1,266 cub. yds. - 12 *s.*	759 12 –			
			990 3 –		
Temporary diversion of water, &c. - - - - -	- - - -	- -	875 – –		
				28,921 17 3	
				30,738 10 7	
Contingencies, 10 per cent. - - -				3,074 9 5	
					33,813 – –
Amount carried forward - - - £.					265,758 – –

	£. s. d.
Amount brought forward - - -	265,758 – –

Killaloe to World's End.

At Parteen :—Removal of shoal.

At O'Brien's Bridge :—Excavation in bed of river above and below bridge; removal of seven old arches of bridge, and substitution of iron girder bridge.

At World's End :—Excavation in bed of river below weir; removal of existing weir and substitution of 11 sets of sluices.

New weir or top of frame of sluices to be 10 feet above upper sill of Errina Lock.

Water must not be allowed to rise higher than six inches below top of sluice frame.

Volume of water provided for 1,200,000 cubic feet per minute.

			£. s. d.	£. s. d.	£. s. d.	£. s. d.
PARTEEN :						
Excavation in bed of river -	14,333 cub. yds. -	1 *s.*	- -	716 13 –		
Land for spoil - - -	- - - -	-	- -	100 – –		
					816 13 –	
O'BRIEN'S BRIDGE :						
Excavation in bed of river above and below bridge - - -	19,564 cub. yds. -	1 *s.*	- -	978 4 –		
Removal of portion of old bridge	- - - -	-	- -	250 – –		
Land for spoil - - -	- - - -	-	- -	150 – –		
Substitution of iron girder bridge in lieu of seven arches of present bridge (three spans of 70 feet each; width of roadway 15 feet) :						
Blocking faced piers, backed with rubble, in mortar -	470 cub. yds. -	16 *s.*	376 – –			
Wrought-iron work - -	75 tons -	- 18 *l.*	1,350 – –			
Cast-iron work - -	2¼ „ -	- 10 *l.*	22 10 –			
Timber flooring - -	3,029 cub. ft. -	3 *s.*	454 7 –			
Coffer dams - - -	- - - -	-	300 – –			
				2,502 17 –		
					3,881 1 –	
WORLD'S END :						
Excavation in bed of river below weir, and removing weir :						
Rock or loose stone - -	55,725 cub. yds	2 *s* 6 *d.*	- -	6,965 12 6		
Sluices :						
Ashlar - - - -	15,866 cub. ft. -	2 *s.*	1,586 12 –			
Rubble in mortar - -	342 cub. yds. -	8 *s.*	136 16 –			
Blocking faced walling in land abutment - - -	170 cub. yds. -	12 *s.*	102 – –			
Sluices - - - -	11 sets at -	700 *l.*	7,700 – –			
				9,525 8 –		
Land for spoil, &c. - - -	- - - -	-	- -	400 – –		
Temporary diversion of water, &c.	- - - -	-	- -	1,000 – –		
					17,891 – 6	
					22,588 14 6	
				Contingencies, 10 per cent. - - -	2,258 5 6	
						24,847 – –
					£.	290,605 – –

J. F. Bateman.

APPENDIX (C).

PARTICULARS of ESTIMATE for TURBINE WHEEL and SLUICES.

Note.—Each set of sluices consists of one turbine, working eight sluices, of an area of 24 square feet each.

	Tons.	*cwts.*	*qrs.*	*lbs.*		£.	*s.*	*d.*	£.	*s.*	*d.*
Cast Iron Work:											
5 Standards for frames	3	12	3	18							
8 Cross girders between standards at sluices	4	1	0	8							
2 Cross girders between standards at turbine	0	9	1	13							
4 Bed plates for sluices	2	6	0	12							
1 Bed plate for turbine	0	16	3	2							
8 Facing plates for sluices	2	1	3	12							
1 Facing plate for turbine	0	8	1	4							
Frame over turbine	0	17	0	15							
8 Plates for crank shaft	1	16	3	12							
5 Main stops on main shafting	3	10	0	20							
4 Intermediate stops on main shafting	1	10	0	0							
3 Brackets to support standards	0	11	2	8							
	22	2	0	12	at 8 *l.* 10*s.* per ton	187	17	11			
8 Sluice frames	3	4	2	16							
4 Pairs of sluice valve guides	0	15	3	8							
8 Sluice doors	4	10	2	8							
Turbine box with cylinders and buckets	3	0	0	3							
	11	11	0	7	at 10 *l.* per ton	115	10	8			
16 Bearings for crank shaft	0	18	3	12							
8 Worm wheels on same	2	12	2	8							
8 Worms on main shafting	0	6	2	0							
5 Couplings - ditto	0	5	2	24							
2 Bushes - ditto	0	2	0	22							
2 Bevil wheels - ditto	0	12	0	2							
1 Coupling clutch	0	2	1	10							
1 Bevil wheel on turbine shaft	0	2	0	6							
2 Small standards for lever	0	0	3	10							
1 Column, including hand wheel and sluice door of turbine	0	3	2	25							
Turbine wheel	0	15	3	12							
Bearing of turbine shaft	0	1	3	18							
Orifice of turbine sluice	0	2	2	5							
	6	7	0	14	at 13 *l.* per ton	79	18	9			
									383	7	4
Wrought Iron Work:											
Main shaft	0	14	3	6							
Turbine shaft	0	4	2	3							
8 Crank shafts	2	1	2	8							
Turbine sluice shaft	0	0	2	17							
Main girders for platform	3	6	0	0							
	6	7	2	6	at 18 *l.* per ton -	114	15	11			
8 Connecting rods	0	12	0	16							
8 Cranks	1	3	0	8							
Lever for gearing	0	1	1	10							
Railing for platform	0	9	1	10							
Gas piping for rail	1	3	2	4							
Screws and bolts	0	14	3	16							
	3	4	1	8	at 35 *l* per ton	112	11	3			
									227	7	2
Steel for pins and bolts	0	1	3	8	at 1 *s.* per lb.	-	-	-	10	4	–
Yellow metal for bushes, bearings, and facing of sluice doors	0	6	2	13	at 1 *s* per lb.	-	-	-	37	1	–
Lead for screws in foundations	0	5	0	0	at 1 *l.* 4 *s.* per cwt.		-	-	6	–	–
									663	19	6
					Fixing same and sundries	-	-	-	36	-	6
								£.	700	-	-

J. F. Bateman.

RIVER SHANNON.

COPY of REPORT by Mr. *J. F. Bateman* on
the INUNDATIONS of the RIVER SHANNON.

(*Mr. Hunt.*)

Ordered, by The House of Commons, *to be Printed,*
20 *June* 1867.

383.

Under 2 *oz.*